CLAIMS

1. A method of producing a magnetic garnet single crystal film formation substrate for growing a magnetic garnet single crystal film by liquid phase epitaxial growth, comprising the steps of:

forming a base substrate composed of a garnet-based single crystal being unstable with a flux used for the liquid phase epitaxial growth;

forming a buffer layer composed of a garnet-based single crystal thin film formed at least on a crystal growing surface of said base substrate and being stable with said flux; and

forming said buffer layer on said base substrate without a positive heating of said substrate when forming said buffer layer on said base substrate.

2. A method of producing a magnetic garnet single crystal film formation substrate for growing a magnetic garnet single crystal film by liquid phase epitaxial growth, comprising the steps of:

forming a base substrate composed of a garnet-based single crystal being unstable with a flux used for the liquid phase epitaxial growth;

forming a buffer layer composed of a garnet-based

single crystal thin film formed at least on a crystal growing surface of said base substrate and being stable with said flux; and

forming said buffer layer on said base substrate by controlling a temperature of said substrate to be from the room temperature to lower than 600°C when forming said buffer layer on said base substrate.

3. The method of producing a magnetic garnet single crystal film formation substrate as set forth in claim 1 or 2, wherein after forming the buffer layer on said base substrate, anneal processing at 600 to 900°C is performed on said buffer layer.

4. The method of producing a magnetic garnet single crystal film formation substrate as set forth in any one of claims 1 to 3, wherein said buffer layer is formed by a thin film formation method.

5. The method of producing a magnetic garnet single crystal film formation substrate as set forth in claim 4, wherein said buffer layer is formed by the sputtering method.

6. The method of producing a magnetic garnet

single crystal film formation substrate as set forth in claim 5, wherein oxygen is included by 30 volume% or less in an atmosphere gas at the time of sputtering when forming said buffer layer by the sputtering method.

7. The method of producing a magnetic garnet single crystal film formation substrate as set forth in claim 5 or 6, wherein input power at the time of sputtering is controlled to 2 to 10 W/cm^2 when forming said buffer layer by the sputtering method.

8. The method of producing a magnetic garnet single crystal film formation substrate as set forth in any one of claims 1 to 7, wherein a flux including a lead oxide and/or a bismuth oxide as a main component of said flux is used.

9. The production method of a magnetic garnet single crystal film formation substrate as set forth in any one of claims 1 to 8, wherein said base substrate has an approximately same thermal expansion coefficient as that of said magnetic garnet single crystal film.

10. The production method of a magnetic garnet single crystal film formation substrate as set forth in

claim 9, wherein a difference between the thermal expansion coefficient of said base substrate and the thermal expansion coefficient of said magnetic garnet single crystal film is within a range of $\pm 2 \times 10^{-6}/°C$ or less in a temperature range of 0°C to 1000°C.

11. The production method of a magnetic garnet single crystal film formation substrate as set forth in any one of claims 1 to 10, wherein said base substrate has an approximately same lattice constant as that of said magnetic garnet single crystal film.

12. The production method of a magnetic garnet single crystal film formation substrate as set forth in claim 11, wherein a difference between the lattice constant of said base substrate and the lattice constant of said magnetic garnet single crystal film is within a range of ±0.02Å or less.

13. The production method of a magnetic garnet single crystal film formation substrate as set forth in any one of claims 1 to 12, wherein said base substrate includes Nb or Ta.

14. The production method of a magnetic garnet

single crystal film formation substrate as set forth in any one of claims 1 to 13, wherein said buffer layer is a garnet-based single crystal thin film substantially not including Nb and Ta.

15. The production method of a magnetic garnet single crystal film formation substrate as set forth in any one of claims 1 to 8, wherein said buffer layer is

expressed by a general formula $R_3M_5O_{12}$ (note that R is at least one of rare earth elements and M is one selected from Ga and Fe)

or

an X-substituted gadolinium gallium garnet (note that X is at least one of Ca, Mg and Zr).

16. The production method of a magnetic garnet single crystal film formation substrate as set forth in any one of claims 1 to 15, wherein a thickness of said buffer layer is 1 to 10000 nm and a thickness of said base substrate is 0.1 to 5 mm.

17. A magnetic garnet single crystal formation substrate produced by using the production method as set forth in any one of claims 1 to 16.

18. A method of producing a magnetic garnet single crystal film, comprising the step of growing a magnetic garnet single crystal film on said buffer layer by using the magnetic garnet single crystal film formation substrate as set forth in claim 17 by a liquid phase epitaxial growth method.

19. A method of producing an optical element, comprising the steps of forming a magnetic garnet single crystal film by using the production method of a magnetic garnet single crystal film as set forth in claim 18, and after that, removing said base substrate and buffer layer so as to form an optical element composed of a magnetic garnet single crystal film.

20. An optical element obtained by the production method of an optical element as set forth in claim 19.